

## ***ORD Source Water Protection***

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USEPA/ORD  
Source Water Managers Meeting  
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## ***ORD Source Water Protection***

- Outline
  - Upper Mississippi River EWS
  - U.S. EPA Organization
  - Office of Research and Development
  - Drinking Water Multi-Year Plan
  - Future Plans
  - Questions



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## Brown's Island, Wierton, WV



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## Why Early Warning Systems?

- Source Waters and Distribution Systems are vulnerable to unreported contamination events
  - River Meuse Hydraulic fluid leak 2004 (de Hoogh et al., 2006. Environ. Sci. Technol., 40 (8), 2678 -2685)
    - Utility closed intake
  - Lake Constance, Germany - intentional Atrazine contamination, 2005
    - Utility added a biomonitoring system
  - Ohio River Methylene Chloride contamination, July 2007
    - Utility added activated carbon filtration
- Early detection of episodic contamination
  - early responses by water utilities and regulatory/response agencies
  - minimize potential impacts and associated costs to the water supply, citizens, and industry that utilize the river



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## Early Warning System Paradigm

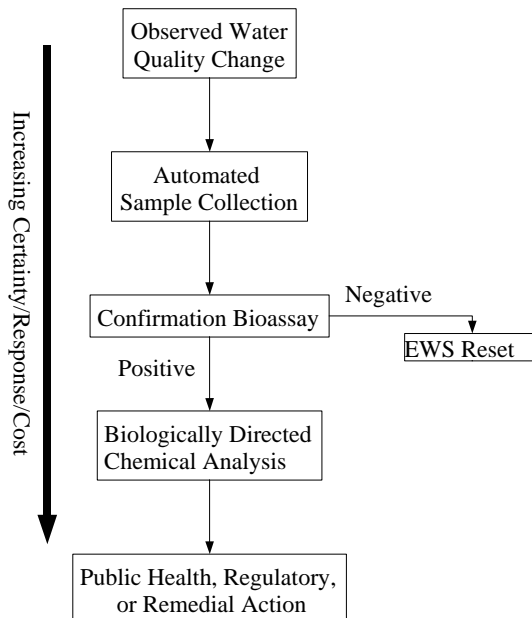
- This EWS paradigm serves as a model for the site specific implementation of EWSs in source waters and distribution systems
  - Water quality monitoring tools
  - Data telemetry
  - Data analysis
  - Information distribution to decision makers
  - Response framework
- Multiple Benefits
  - Source Water
    - Quality
    - Ecological Status
    - TMDL
    - Drinking Water Process Control
  - Distribution System
    - Water Quality Monitoring
    - Water Security



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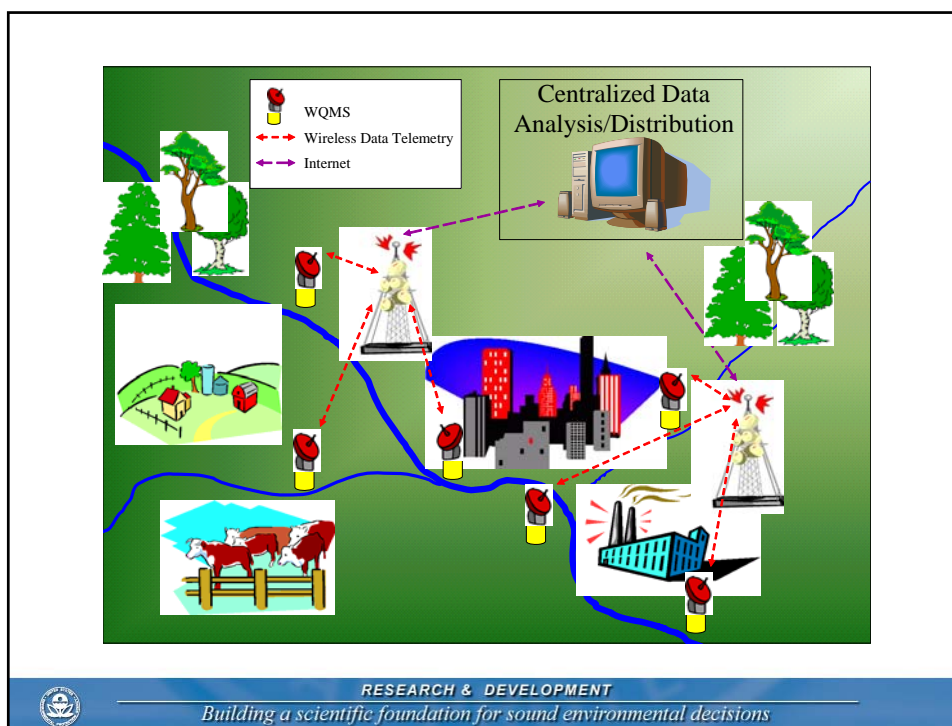
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## Tiered Response Model



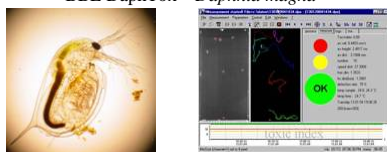
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## On-Line Toxicity Monitors "Canary in the Coal mine"

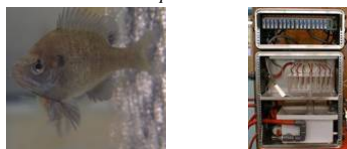
BBE DaphTox – *Daphnia magna*



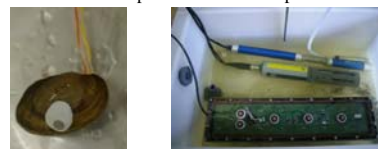
Microlan ToxControl – *Vibrio fischeri*



IAC iABS – *Lepomis macrochirus*



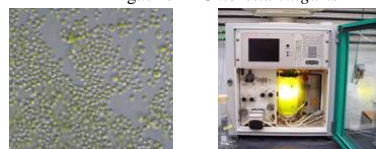
Bivalve Gape Monitor – Non-specific



BBE ToxProtect – *Pimephales promelas*



BBE AlgaeTox – *Chlorella vulgaris*



## Water Quality Monitoring Tools

- On-line Toxicity Monitors
  - Bivalve Gape
  - Bacteria Luminescence
  - Fish Behavior/Mortality
- Physical/Chemical Sensors
  - Multiparameter Sonde
  - UV/Vis Spectrometer



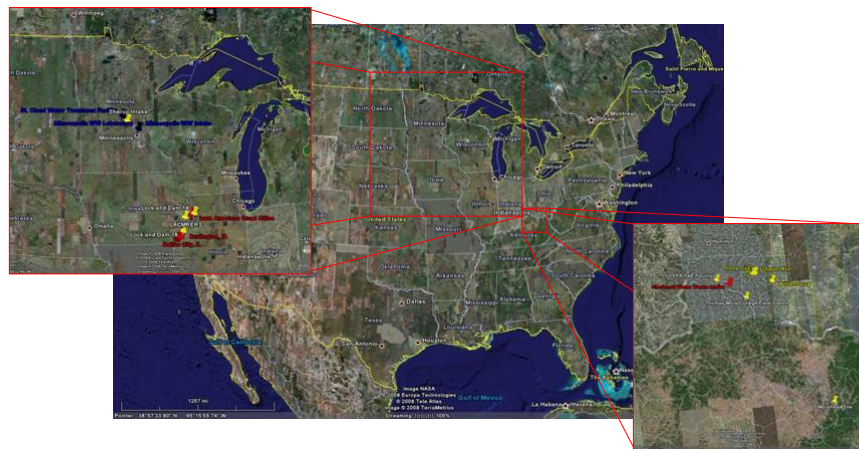
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## OTMs for Source Water Monitoring and Ecological Protection

Upper Mississippi River  
Early Warning Network

Cincinnati Area Pilot EWS



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## Field Implementation Collaboration!!!

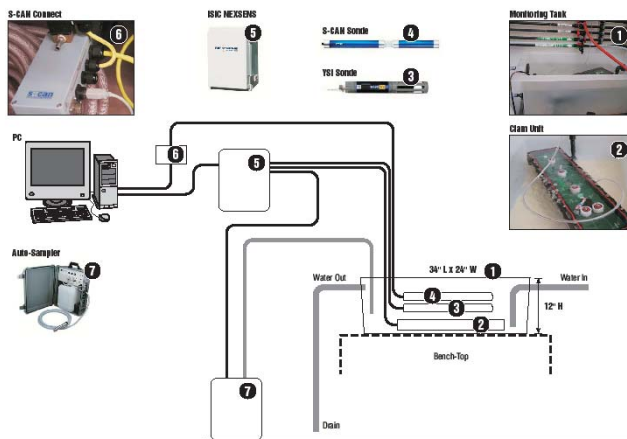
- Upper Mississippi River Early Warning Network
  - Federal
    - U.S. EPA ORD & Region 5
  - State
    - MN Pollution Control Agency
    - MN Dept. of Nat. Res.
    - Iowa Dept. of Nat. Res.
  - Regional
    - Upper Miss. River Basin Assoc
  - Utilities
    - Minneapolis Water Works
    - St. Cloud, MN Water Works
    - Moline, IL Water Works
    - American Water
    - Xcel Energy
  - Universities
    - St. Cloud State University
    - University of MN
    - University of Iowa
- East Fork of the Little Miami River
  - Federal
    - U.S. EPA ORD
  - Local
    - Clermont County
  - Utilities
    - Morehead, KY Water Utility
  - Universities
    - Thomas More College
    - Morehead University



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## Water Quality Monitoring Tools



Online Toxicity Monitoring Station Schematic



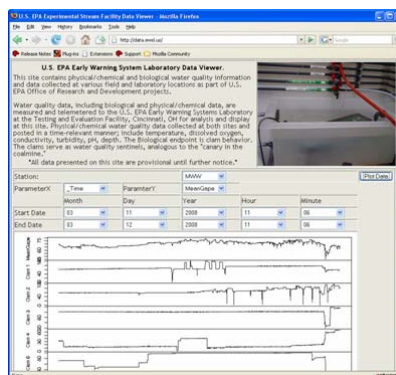
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## Data Telemetry, and Storage

- Data Telemetry is site specific
  - LAN connection, DSL, Cell
  - Software solution from Nexsens handles data packaging and transmission with direct insertion of data via ODBC connection
- Data Storage
  - MySQL database
    - Data are replicated and backed up on regular schedule



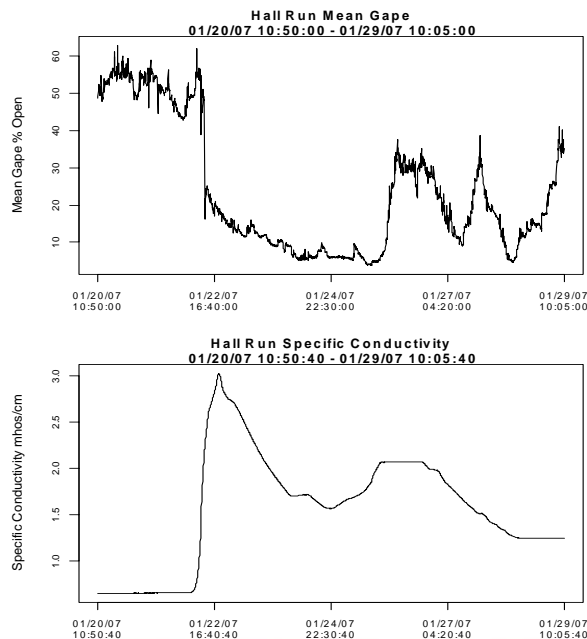
## Data Analysis and Communication

- Data are analyzed using the R statistical environment to detect bivalve behavioral triggers
  - Exponentially Weighted Moving Average
  - AutoRegressive process
- Reports are generated daily and emailed to stakeholders
- Interactive web-based tool available for data exploration
- Alarm event notification via email to cell phone/pager



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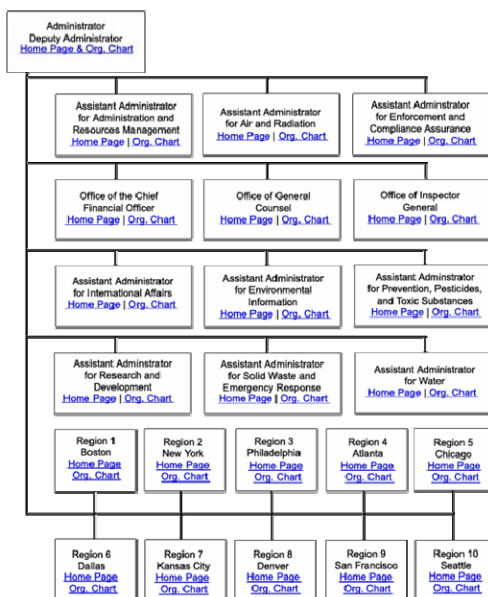


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# U.S. EPA Organization

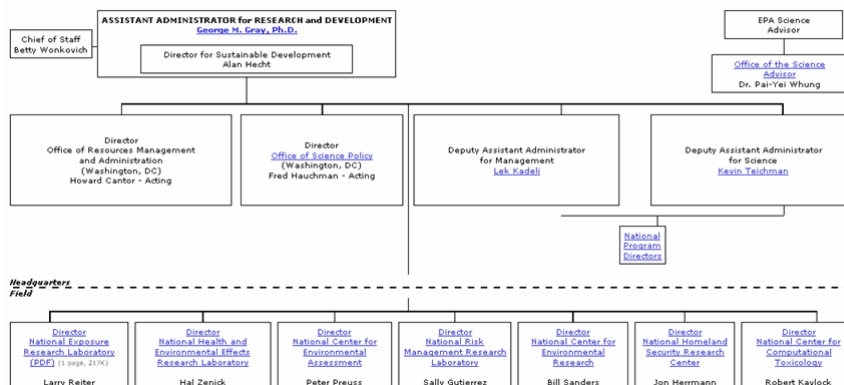


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# Office of Research and Development

ORD Organization Chart  
Last Updated 10/16/2007



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## Research and Development at EPA



- 1,950 employees
- \$700 million budget
- \$100 million extramural research grant program
- 13 lab or research facilities across the U.S.
- Credible, relevant and timely research results and technical support that inform EPA policy decisions



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## National Research Programs

### National Research Programs

This site provides information about the national research programs in EPA's Office of Research and Development (ORD), the research arm of the Agency. The research programs coordinate research planning to address EPA's science needs to protect the environment and public health. ORD research reduces uncertainties in environmental decision making and helps develop cost-effective strategies to reduce risk.

The national research programs provide the science to support EPA's goals as outlined in [EPA's strategic plan](#) and [ORD's strategic plan](#).

ORD has identified eight national research programs. They are:



Clean Air Research Program



Human Health Research Program



Drinking Water Research Program



Land Research Program



Ecological Research Program



Pesticides and Toxic Substances Research Program



Global Change Research Program



Water Quality Research Program

**Resources**

- Multi-Year Plans
- ORD Strategic Plan
- EPA Strategic Plan
- Research Strategies
- Science Inventory



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### Overview of DWRP LTG1 research approaches for characterization of the quality, quantity, and sustainability of drinking water sources

Approach	Goal	Example contaminants
Monitoring	Contaminant occurrence (introduction or mobilization) Early warning systems Source tracking Treatment requirements	Fecal contamination Pathogens (viruses) Chemical indicators
Modeling, mapping, and field validation	Ground water recharge rates, residence times, zones of influence Fate and transport Precipitation, dissolution, mobilization	Nutrients Tracers (salts, isotopes) Geospatial data
Water availability	Linking water quality changes to land-use, water use practices, water availability Smart-growth planning	Biota Minerals Dissolved gases Metals Organics



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### Overview of DWRP LTG2 research approaches for characterization of watershed-based management approaches to protect and sustain water quality and availability

Category	Research Emphasis	Key Elements
Water Quality	Incorporation of surface water-ground water interfaces and interconnectivity into risk management strategies Structural and nonstructural BMP implementation and performance of BMPs in relation to watershed characteristics	Watershed based control of contaminants Organic content and DBPs Microbial contamination Benchmarks of BMP effectiveness
Water Quantity	Geologic sequestration of carbon dioxide Groundwater recharge and aquifer storage and recovery	
Water sustainability	Relationship between source water protection, water quality, treatment requirements, and public health protection "Green" communities Water quality and quantity safeguards for alternative fuels	Conservation Ecological Services



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## **DWMYP Focus Areas**

- Water-Energy Interdependencies
  - Geologic Sequestration of Anthropogenic Carbon Dioxide
  - Biofuels
  - Low-Impact-Development and “Green” Communities
  - Impacts of changing energy availability on treatment chemicals for producing and delivering drinking water



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**Source Water/Water Resources**  
 Annual performance goal (APG)  
 Annual performance measure (APM)

**Develop tools, methods, models, and data for assessing efficacy, improving implementation, and scaling of structural and non-structural Best Management Practices (BMPs) to achieve macro-scale source water/water quality protection**

Provide data and information on BMPs to improve source water quality

**Develop guidance for modeling and monitoring of geologic sequestration sites**

Evaluate capabilities of currently available hydrologic and geochemical models

Semi-analytical Models of Geologic Carbon Sequestration for Evaluation of the Area of Review, Time-Dependent Areas of Potential Corrective Action, and Leakage through Abandoned Wells

Use of Soil-Gas and Ground-Water Monitoring to Detect Leakage from Plugged Abandoned Wells

Integrated design, modeling, and monitoring of geologic sequestration of anthropogenic carbon dioxide to safeguard sources of drinking water

**Tools for integrating water sustainability into “green communities”**

Hydrologic modeling to protect/preserve critical water resources at the municipal level

Use of geospatial data to map development and inform smart-growth planning

Mapping Regional Development for Smart Growth Planning to Minimize Degradation of Water Quality and Enhance Green Infrastructure



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## ***Related Current and Future Work***

- Continue EFLMR Monitoring
- Complete Implementation of Upper Mississippi Early Warning Network
  - 6 sites from St. Cloud, MN to St. Louis, MO by end of 2009
- Rapid TIE Methodology
- Further assessment of Distribution System Monitoring



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## ***Summary Conclusions***

- EWS/Tiered Response Model Paradigm
- Laboratory results demonstrate OTMs toxicologically appropriate for Distribution Systems and Source Waters
- Upper Mississippi EWS
  - Field deployments demonstrate technological feasibility
  - Collaboration is critical for completion of projects at this scale



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